



INTELLIGENT MOTION SYSTEMS, INC.

Excellence in Motion™

IM481H

**ULTRA MINIATURE HIGH PERFORMANCE
MICROSTEPPING DRIVE**

OPERATING INSTRUCTIONS




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*IM481H Ultra Miniature High Performance Microstepping Drive
Revision 05.12.05*

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SECTION	PAGE
1 LIST OF TABLES AND FIGURES	1
2 INTRODUCTION	2
3 PIN ASSIGNMENT AND DESCRIPTION	3
4 ELECTRICAL SPECIFICATIONS	4
5 THERMAL SPECIFICATIONS	4
6 MECHANICAL SPECIFICATIONS	
6.1 DIMENSIONAL INFORMATION	5
6.2 MOUNTING INFORMATION	6
7 OUTPUT CURRENT	
7.1 DETERMINING OUTPUT CURRENT	7
7.2 SETTING OUTPUT CURRENT	8
7.3 RESISTOR TABLE	9
8 MOTOR	
8.1 MOTOR SELECTION	10
8.2 CONNECTING THE MOTOR	10
9 POWER REQUIREMENTS	
9.1 MOTOR POWER	12
9.2 +5 VDC INPUT	13
10 LAYOUT AND INTERFACE GUIDELINES	14
11 MICROSTEP SELECTION	14
12 FULLSTEP OUTPUT SIGNAL	16
13 TIMING	16
14 INPUTS	17
15 AUTOMATIC CURRENT REDUCTION	18
16 FAULT PROTECTION	19
18 THERMAL REQUIREMENTS	19
19 OPTIONS/ACCESSORIES	20
Appendix A - Recommended Cable Configurations	21
WARRANTY	30

LIST OF FIGURES

Figure 1	DIMENSIONAL INFORMATION	4
Figure 2	MOUNTING INFORMATION	6
Figure 3	SETTING OUTPUT CURRENT	9
Figure 4	MOTOR CONNECTIONS	12
Figure 5	POWER CONNECTIONS	14
Figure 6	MICROSTEP RESOLUTION SELECTION	16
Figure 7	INPUTS	18
Figure 8	FAULT IN/RESET - INTERFACE CIRCUIT	18
Figure 9	RESET TIMING	18
Figure 10	MULTIPLE DRIVES - ONE RESET	18
Figure 11	AUTOMATIC CURRENT REDUCTION	19

LIST OF TABLES

Table 1	ELECTRICAL SPECIFICATIONS	4
Table 2	THERMAL SPECIFICATIONS	4
Table 3	RESISTOR TABLE	10
Table 4	POWER SUPPLY SPECIFICATIONS	13
Table 5	MICROSTEP SELECTION	15

SECTION 2

INTRODUCTION

The IM481H is a high performance, yet low cost microstepping driver that utilizes advanced hybrid technology to greatly reduce size without sacrificing features. The IM481H is exceptionally small, easy to interface and use, yet powerful enough to handle the most demanding applications.

The IM481H has 14 built in microstep resolutions (both binary and decimal). The resolution can be changed at any time without the need to reset the driver. This feature allows the user to rapidly move long distances, yet precisely position the motor at the end of travel without the expense of high performance controllers.

With the development of proprietary and patented circuits, ripple current has been minimized to reduce motor heating common with other designs, allowing the use of low inductance motors improving high speed performance and system efficiency.

The IM481H, because of its ultra small size and low cost, can be used to increase accuracy and smoothness in systems using higher step angle motors. In many instances mechanical gearing can be replaced with microstepping, reducing cost and eliminating potential maintenance.

OPTIONAL INTERFACE BOARD The INT-481 is a plug on interface board which can be used with the IM481H to facilitate testing or in situations where panel mounting is preferred

The INT-481 contains extra circuitry which includes: Opto isolators for step clock, direction, enable, and reset, along with extra fault detection circuits, +5vdc supply, input capacitor, and fault and power LED's. Wiring is done through a 15 pin screw terminal header. A four position dip switch is supplied for microstep resolution selection.

FEATURES

- Very Low Cost
- Ultra Miniature 1.1" x 2.7" x 0.17"
- High Input Voltage (+12 to +48Vdc)
- High Output Current (1.5 Amps RMS, 2.3 Amps Peak)
- Advanced Hybrid Design
- Replaces Mechanical Gearing for Smoothness and Positioning
- Designed for High Performance, Low Inductance Stepping Motors
- 20 KHz Chopping Rate
- Up to 10 MHz Step Clock Rate
- 14 Selectable Microstepping Resolutions that can be changed On-The-Fly.
- Up to 51,200 Steps/Rev with a 1.8° Motor
- Automatically Switches between Slow and Fast Decay for Unmatched Performance
- At Full Step Output

SECTION 3

PIN ASSIGNMENT AND DESCRIPTION

PIN #	PIN NAME	PIN FUNCTION
1,2	PHASE A	Phase A of the stepping motor is connected between pin 1 and pin 2. See section 8.
3	CURRENT REDUCTION ADJUST	Phase current reduction adjustment input. A resistor connected between this pin and pin 4 (if used to set motor phase current) will proportionately reduce current in both windings approximately .5 seconds after the last positive edge of the step clock input. See section 15.
4	CURRENT REFERENCE	Phase current reference output. A resistor is connected between this 1 mA current source output and the Ground pin (pin 11) to generate the voltage used to set the peak phase current in the motor. See section 7.
5	CURRENT ADJUSTMENT	Phase current adjustment input. A voltage applied to this input sets the peak phase current in the motor. See section 7.2.
6	FAULT INPUT	A low signal on this input will generate a latched fault condition. See section 16.
7-10	RESOLUTION SELECT 0-3	Microstep resolution select inputs. Used to select the number of microsteps per step of the motor. See section 11.
11	SUPPLY GROUND	Supply voltage ground (return). See section 9.
12	+V	Supply voltage input. See section 9.
13	RESET INPUT	When low, this input will reset the driver (phase outputs will disable). When released, the driver will be at its initial state (phase A off, phase B on). See section 14.
14	+5V	+5Vdc supply input. This supply is used to power the internal logic. The +5Vdc supply should be referenced to pin 11(supply ground). See section 9.2.
15	STEP CLOCK INPUT	A positive going edge on this input advances the motor one increment. The size of the increment is dependent on the microstep select inputs See section 13.
16	DIRECTION INPUT	This input is used to change the direction of the motor. Physical direction also depends on the connection of the motor windings. See section 13.
17	ENABLE INPUT	This input is used to enable/disable the output section of the driver. When high, the outputs are enabled. However, this input does not inhibit the step clock. Therefore when enabled the outputs will update by the number of clock pulses (if any) applied to the driver while it had been disabled. See section 14.
18	ON-FULL-STEP OUTPUT	This totem-pole output indicates when the driver is positioned at a full step. This output can be used to count the number of full steps the motor has moved, regardless of the number of microsteps in between. This output is active high. See section 12.
19	FAULT OUTPUT	This totem-pole output indicates a short circuit has occurred or a low signal was detected on the Fault input. This output is active high. See section 16
20-21	PHASE B	Phase B of the stepping motor is connected between pin 20 and pin 21. See section 8.

SECTION 4

ELECTRICAL SPECIFICATIONS

Table 1

Test Parameters: $T_A = 25^{\circ}\text{C}$, $+V = 48\text{V}$

<u>TEST CONDITION</u>	<u>MIN</u>	<u>TYP</u>	<u>MAX</u>	<u>UNITS</u>	
INPUT VOLTAGE	12	45	48*	V	
PHASE OUTPUT CURRENT	RMS	0.14	1.5	A	
PHASE OUTPUT CURRENT	PEAK		2.3	A	
QUIESCENT CURRENT (+v, pin 12).....	INPUTS/OUTPUTS FLOATING	25		mA	
QUIESCENT CURRENT (+5vdc, pin 14)....	INPUTS/OUTPUTS FLOATING		40	mA	
ACTIVE POWER DISSIPATION	$I_{OUT} = 1\text{A RMS}$		2.0	W	
LOW LEVEL INPUT VOLTAGE	ALL INPUTS		0.8	V	
HIGH LEVEL INPUT VOLTAGE	ALL INPUTS EXCEPT RESET	2.0		V	
HIGH LEVEL INPUT VOLTAGE	RESET	2.3		V	
INPUT PULL-UP RESISTANCE	FAULT IN, RES SEL 0-3, ENABLE	4.4	4.7	5.0	k Ω
INPUT PULL-UP RESISTANCE	STEP CLOCK, DIRECTION	2.1	2.2	2.3	k Ω
INPUT PULL-UP RESISTANCE	RESET	0.9	1.0	1.1	k Ω
LOW LEVEL OUTPUT CURRENT	FAULT, FULLSTEP	24		mA	
HIGH LEVEL OUTPUT CURRENT	FAULT, FULLSTEP	-2		mA	
LOW LEVEL OUTPUT VOLTAGE	$I_{OL} = 24\text{ mA}$		0.4	V	
HIGH LEVEL OUTPUT VOLTAGE	$I_{OH} = -2\text{ mA}$	4.5		V	

* INCLUDES BACK EMF OF MOTOR

SECTION 5

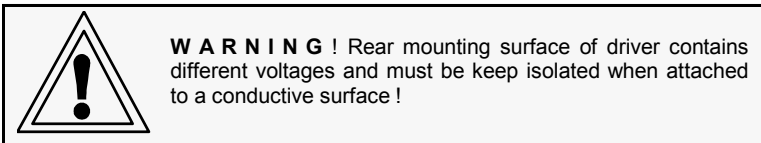
THERMAL SPECIFICATIONS

Table 2

STORAGE TEMPERATURE	-40 TO +125 $^{\circ}\text{C}$
OPERATING TEMPERATURE.....	0 TO +50 $^{\circ}\text{C}$
‡REAR MOUNTING SURFACE (MAX)	+70 $^{\circ}\text{C}$

‡ADDITIONAL COOLING MAY BE REQUIRED TO LIMIT REAR MOUNTING SURFACE

Care should be taken when choosing a heatsink to ensure that there is good thermal flow, otherwise hot spots may occur in the IM481H which will reduce the effectiveness of the thermal protection.



NOTE: An optional thermal pad (**Part # TI-481**) and heat sink (**Part # H-481**) is available for the IM481H

SECTION 6.1

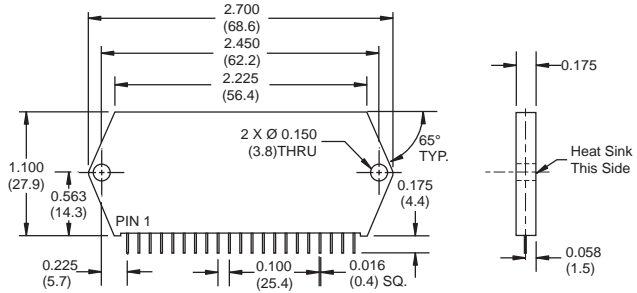
MECHANICAL SPECIFICATIONS

DIMENSIONAL INFORMATION

Dimensions in Inches (mm)

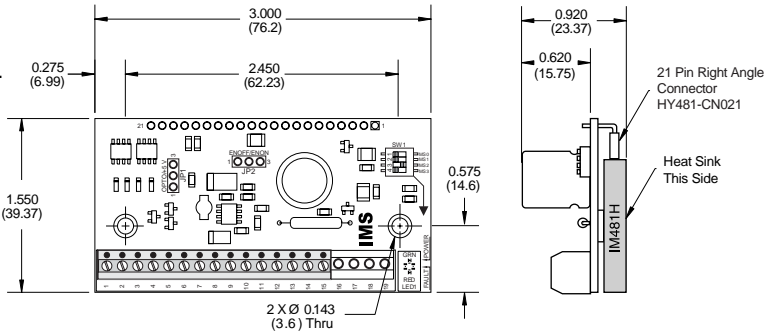
IM481H

*Wt: 0.512 oz.
14.6 gms.



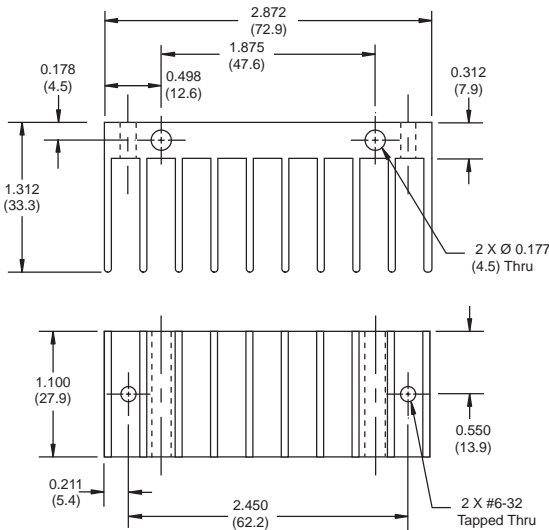
INT-481

*Wt: 1.02 oz.
29.0 gms.



H-481

*Wt: 2.40 oz.
68.1 gms.

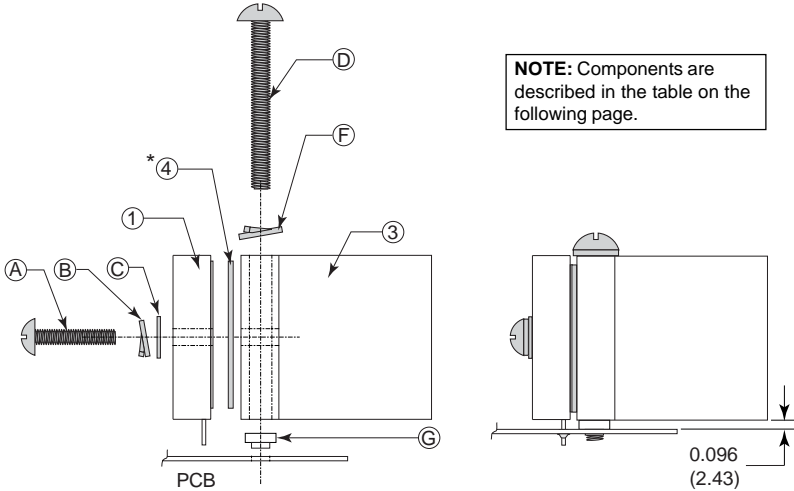


* Does not include mounting hardware.

SECTION 6.2

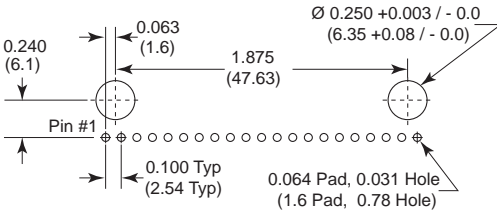
MOUNTING INFORMATION

IM481-H Driver and H-481 Heat Sink Direct Mount on PCB

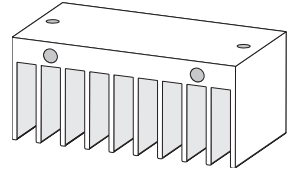


Hole Pattern for Direct PCB Mounting

Dimensions are in Inches (mm)



H-481 Heat Sink



NOTE: The hardware items "A" through "H" are supplied with the H-481 Heat Sink Kit. If the H-481 is not used, the mounting hardware is not supplied.

NOTE: The torque specification for the #6-32 INT-481 and IM481H mounting screw is 5.0 - 7.0 in-lbs. (See the hardware list on the following page.)

* The Isolating Thermal Pad (TI-481) item "4" is supplied with the INT-481 Interface Board. If the INT-481 is not used, the Thermal Pad must be ordered separately.

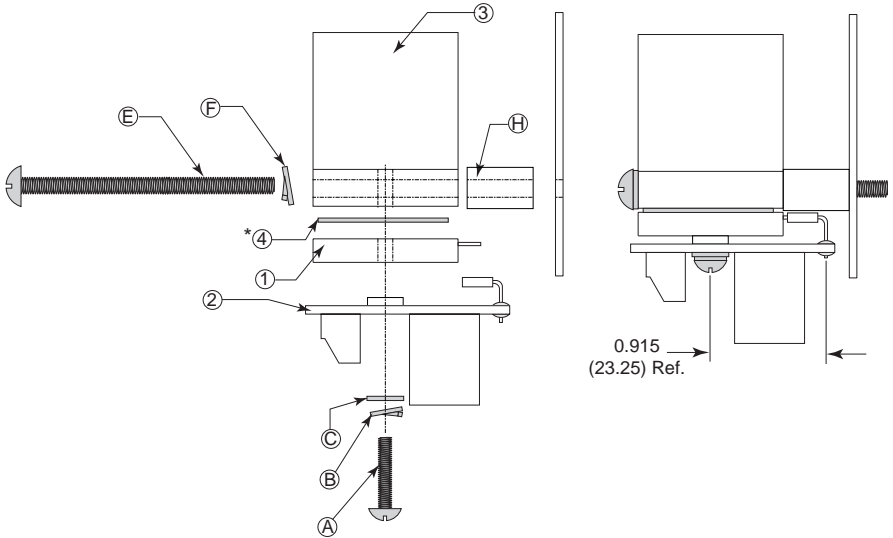


WARNING! The Heat Sink mounting surface must be a smooth, flat surface with no burrs, protrusions, cuttings or other foreign objects.

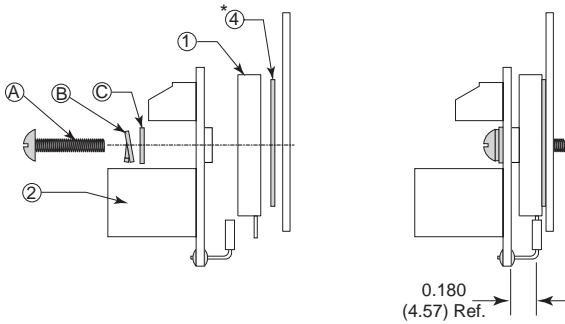


WARNING! If you are planning to wash your PCB it must be done prior to adding the IM481H Driver or damage will occur.

IM481-H Driver, INT-481 Interface Board, H-481 Heat Sink Panel Mount



IM481-H Driver, INT-481 Interface Board Panel Mount without Heat Sink



Product/Item #	Description	Qty.
1	IM481H Microstepping Driver	1
2	INT-481 Interface Board	1
3	H-481 Heat Sink	1
4	TI-481 Isolating Thermal Pad	1
A	#6-32x5/8" Pan Head Screw	2
B	#6 Split Lock Washer	2
C	#6 Flat Washer, 0.250" OD, 0.145" ID, 0.030" Thick	2
D	#8-32x13/8" Pan Head Screw	2
E	#8-32x2 Pan Head Screw	2
F	#8 Split Lock Washer	2
G	#8-32 Internally Threaded Broaching Nut	2
H	Spacer, 0.312" OD, 0.171" ID, 0.500" Long	2

* The Isolating Thermal Pad (TI-481) item "4" is supplied with the INT-481 Interface Board. If the INT-481 is not used, the Thermal Pad must be ordered separately.

OUTPUT CURRENT

SECTION 7.1

DETERMINING THE OUTPUT CURRENT

For any given motor, the OUTPUT CURRENT used for MICROSTEPPING is determined differently from that of a HALF/FULL STEP driver.

In the IM481H, a sine/cosine output function is used in rotating the motor. Therefore, when microstepping, the specified phase current of the motor is considered an RMS value.

The CURRENT ADJUSTMENT RESISTOR used to set the output current of the IM481H sets the peak output of the sine/cosine waves not the RMS value. Therefore the specified motor current (which is the RMS value) should be multiplied by 1.4 to determine the PEAK value to which the IM481H will be set.

EXAMPLE:

If a motor has a specified PHASE CURRENT of 0.75 amps per phase, then:

$$0.75 \text{ amps} \times 1.4 = 1.05 \text{ amps peak}$$

The Resistor Value = OUTPUT CURRENT X 1000 or in this example:

$$1.05 \times 1000 = 1050 \Omega.$$

Table 3 shows commercially available 1% resistors for a given current.

NOTE: Stepper motors can be configured as 4, 6, or 8 leads. Each configuration requires different currents. Shown below are the different lead configurations and the procedures to determine their output current.

4 Lead Motors: Multiply the specified phase current by 1.4 to determine the peak output current.

6 Lead Motors: 1) When configuring a 6 lead motor in a half coil configuration (i.e. connected from one end of the coil to the center tap (high speed configuration)) multiply the specified per phase (or unipolar) current rating by 1.4 to determine the peak output current.

2) When configuring the motor so the full coil is used (i.e. connected from end to end with the center tap floating (higher torque configuration)) use the per phase (or unipolar) current rating as the peak output current.

8 Lead Motors: **SERIES CONNECTION:** When configuring the motor windings in series, use the per phase (or unipolar) current rating as the peak output current, or multiply the bipolar current rating by 1.4 to determine the peak output current.

PARALLEL CONNECTION: When configuring the motor windings in parallel, multiply the per phase (or unipolar) current rating by 1.96 or the bipolar current rating by 1.4 to determine the peak output current.

NOTE: After determining the peak output current, use table 4 to choose the proper current reference resistor value.

SECTION 7.2

SETTING OUTPUT CURRENT

The OUTPUT CURRENT on the IM481H is set by applying a voltage to pin 5 (current adjustment). The output current is set as follows:

$$\text{PEAK OUTPUT CURRENT (Amps)} = \text{Volts applied to pin 5}$$

EXAMPLE:

1.4 volts applied to pin 5 will set the peak output current of the IM481H to 1.4 amps per phase.

To generate the reference voltage needed to set the peak output current of the driver, a 1mA current source is provided (pin 4, Current Reference). By connecting a resistor (1/8 watt or higher) between pin 4 and pin 11 (Ground) a reference voltage is generated. Pin 4 is then connected to pin 5 (Current Adjustment) to set the peak per phase output current of the driver (See Figure 3).

The relationship between the output current and the resistor value is as follows:

$$\text{PEAK OUTPUT CURRENT (Amps)} \times 1000 = \text{Resistor Value (Ohms)}$$

EXAMPLE: To set the peak output current of the IM481H to 1.4 Amps:

$$1.4 \div .001 = \text{Resistor Value} = 1400 .$$

Table 3 shows the standard 1% resistor values with respect to the peak output current.

NOTE: When using the Current Reference output to set the output current of the IM481H, care should be taken to keep the connections as short as possible to help minimize the noise coupled into the driver.

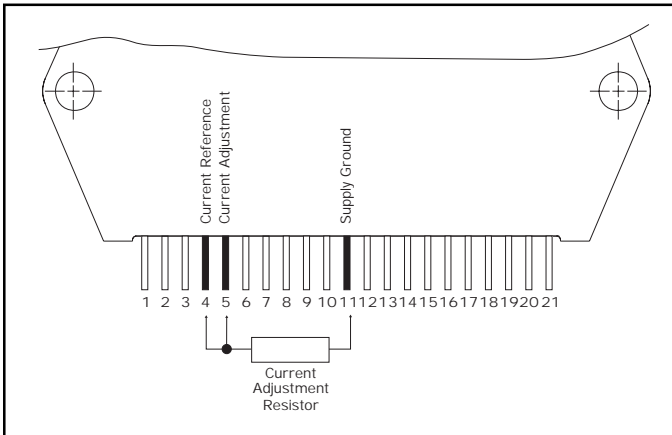


Figure 3



WARNING! A Current Adjustment Resistor is always necessary to keep the Driver and/or Motor in safe operating range.
DO NOT operate the IM481H Driver without a Current Adjustment Resistor!

SECTION 7.3

RESISTOR TABLE

Table 3

PEAK OUTPUT CURRENT (AMPS)	REFERENCE (VOLTS)	RESISTOR VALUE (1%) (OHMS)
0.20.....	0.20.....	200
0.25.....	0.25.....	249
0.30.....	0.30.....	301
0.35.....	0.35.....	348
0.40.....	0.40.....	402
0.45.....	0.45.....	453
0.50.....	0.50.....	499
0.55.....	0.55.....	549
0.60.....	0.60.....	604
0.65.....	0.65.....	649
0.70.....	0.70.....	698
0.75.....	0.75.....	750
0.80.....	0.80.....	806
0.85.....	0.85.....	845
0.90.....	0.90.....	909
0.95.....	0.95.....	953
1.00.....	1.00.....	1000
1.05.....	1.05.....	1050
1.10.....	1.10.....	1100
1.15.....	1.15.....	1150
1.20.....	1.20.....	1210
1.25.....	1.25.....	1240
1.30.....	1.30.....	1300
1.35.....	1.35.....	1330
1.40.....	1.40.....	1400
1.45.....	1.45.....	1430
1.50.....	1.50.....	1500
1.55.....	1.55.....	1540
1.60.....	1.60.....	1580
1.65.....	1.65.....	1650
1.70.....	1.70.....	1690
1.75.....	1.75.....	1740
1.80.....	1.80.....	1780
1.85.....	1.85.....	1820
1.90.....	1.90.....	1870
1.95.....	1.95.....	1960
2.00.....	2.00.....	2000
2.05.....	2.05.....	2050
2.10.....	2.10.....	2100



WARNING! Although stepping motors will run hot when configured correctly, damage may occur to a motor if a higher than specified current is used. Most specified motor currents are maximum values. Care should be taken when exceeding these ratings.

MOTOR

SECTION 8.1

MOTOR SELECTION

The IM481H is a Bipolar driver which works equally well with both Bipolar and Unipolar motors, (i.e. 8 and 4 lead motors and 6 lead center tapped motors (see section 8.2, Connecting the Motor)).

To maintain a given set motor current, the IM481H chops the voltage using a constant chopping frequency and a varying duty cycle. Duty cycles that exceed 50% can cause unstable chopping. This characteristic is directly related to the motor's winding inductance. To avoid this situation, it is necessary to choose a motor with a low winding inductance. The lower the winding inductance, the higher the step rate possible.

The maximum per phase motor inductance for the IM481H is calculated as follows:

$$\text{Max. per Phase Inductance (mH)} = 2 \times \text{Supply Voltage} \div 10$$

NOTE: In calculating the maximum phase inductance, when using an unregulated power supply, the minimum supply output voltage should be used.

Since the IM481H is a constant current source, it is not necessary to use a motor that is rated at the same voltage as the supply voltage. What is important is that the IM481H is set to the motor's rated current.

The higher the voltage used the faster the current can flow through the motor coils. This in turn means a higher step rate. Care should be taken not to exceed the maximum voltage of the driver.

Therefore in choosing a motor for a system design, the best performance for a specified torque is a motor with the lowest possible winding inductance used in conjunction with the highest possible driver voltage.

SECTION 8.2

CONNECTING THE MOTOR

Phase A of the Stepping Motor is connected between pins 1 and 2. Phase B of the Stepping Motor is connected between pins 20 and 21. The following drawings in figure 4 illustrates the connection of 4,6, and 8 Lead Stepping Motors to the IM481H Driver.

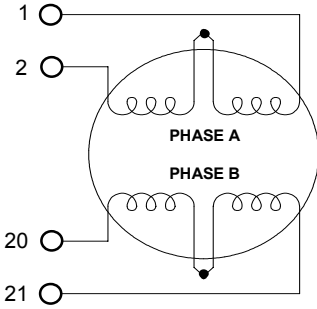
NOTE: To reduce the transmission of EMI from the motor cables, a twisted pair shielded cable is recommended if the driver to motor cabling is in excess of one foot. Motor leads should not exceed 100 feet. Refer to Section 10, Recommended Wiring, for further information.

NOTE: The physical direction of the motor with respect to the direction input will depend on the connection of the motor windings. To reverse the direction of the motor with respect to the direction input, switch the wires on either phase A or phase B outputs.

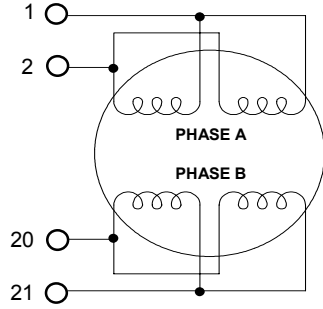


WARNING! Do not connect or disconnect the AC power leads or the motor leads with power applied!

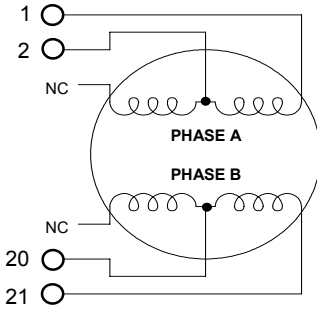
MOTOR CONNECTIONS



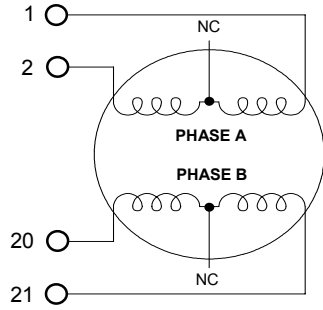
**8 LEAD MOTOR
SERIES CONNECTION**



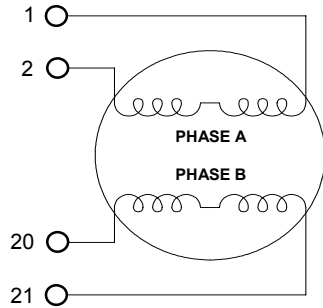
**8 LEAD MOTOR
PARALLEL CONNECTION**



**6 LEAD MOTOR
HIGHER SPEED CONFIGURATION
(HALF COIL)
NC: NO CONNECTION**



**6 LEAD MOTOR
HIGHER TORQUE CONFIGURATION
(FULL COIL)
NC: NO CONNECTION**



4 LEAD MOTOR

Figure 4

POWER REQUIREMENTS

SECTION 9.1

MOTOR POWER

Pins 11 (ground), and 12 (+V) are used to connect the motor DC power to the IM481H. Two local capacitors are needed, connected between pins 11 and 12 and located as close to the pins as possible, to insure stable operation.

The first capacitor is a low impedance, aluminum electrolytic. The continuous operating voltage of the capacitor should exceed the maximum supply voltage as well as any additional voltage caused by the motors back EMF. The value of the capacitor should be approximately 150 microfarads for every 1 amp of peak per phase output current.

EXAMPLE: For a peak output current of 1.4 amps, and a supply voltage of 45 volts, a 220uf 50v capacitor is recommended.

Along with the aluminum electrolytic, a 0.1 microfarad ceramic capacitor must be used to filter out high frequency noise. It should be located between the IM481H's power input pins and the aluminum electrolytic capacitor. The continuous operating voltage of the capacitor should exceed the maximum supply voltage as well as any additional voltage caused by the motors back EMF.

POWER SUPPLY SPECIFICATIONS

Table 4

Recommended Type:.....	Unregulated DC.
Ripple Voltage.....	±10% max.
Output Voltage.....	+12 to +45Vdc
*Output Current.....	0.75 Amps (TYPICAL)

NOTE: RECOMMENDED POWER SUPPLY IMS: PART # ISP200-4

NOTE: With the exception of IMS Power Supplies, Switching Power Supplies and regulated linears with overcurrent protection are not recommended because of their inability to handle surge currents. If multiple drivers are to be run off of one power supply each drive should have separate power and ground wires that connect directly to the output capacitor of the power supply.

**THE OUTPUT CURRENT NEEDED IS DEPENDENT ON THE SUPPLY VOLTAGE, MOTOR SELECTION, AND LOAD.*



W A R N I N G : When using an unregulated power supply, care should be taken that the output voltage does not exceed the maximum driver input voltage because of variations in line voltage. It is recommended that a input line filter be used on the power supply to limit voltage spikes to the driver!!



W A R N I N G : Do not connect or disconnect motor leads with power applied !! Do not connect or disconnect power supply with power applied !!

SECTION 9.2

+5 VDC INPUT

The IM481H requires an external regulated +5Vdc power supply. The supply is connected between pins 11 (ground), and 14 (+5vdc). A 22 microfarad 10v tantalum capacitor must be placed as close to the IM481H as possible between the +5vdc input pin (14) and ground.

The +5vdc supply ground and the motor supply ground should not be connected together at the power supplies. The common ground connection between the motor power supply and the +5vdc supply should be made at the ground pin of the additional electrolytic capacitor used for the motor supply (see section 9.1)

Figure 5 shows the proper connection of the external +5vdc supply to the IM481H.

NOTE: Care should be taken when using this supply not to couple noise from external circuits into the IM481H which could cause erratic operation or damage.

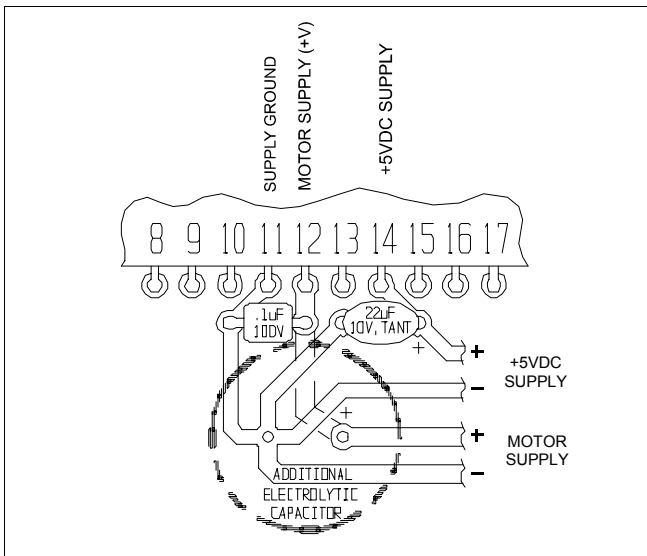


Figure 5

SECTION 10

LAYOUT AND INTERFACE GUIDELINES

Logic level signals should not run parallel to motor phase signals. The motor phase signals will introduce noise into the logic level signals and can make the system unreliable. Motor phase signals should run as pairs and should be separated from other signals by ground traces where possible.

When leaving the board, motor cables should not be run parallel with other wires and phases should be wired using twisted pairs. If motor cabling in excess of 1 foot is required, the use of a shielded twisted pair cable is recommended to reduce the transmission of EMI. The shield must be tied to AC ground at the driver end only. The motor end must be left floating.

If more than one driver is to be connected to the same power supply, separate power and ground connections from each driver to the power supply should be used.

The power supply cables need to be a twisted pair if power is connected from a source external to the board. If multiple drivers are used with an external power source, and it is not possible to run separate power and ground connections to each driver, a low impedance electrolytic capacitor equivalent to 2 times the total capacitance of all the driver capacitors (see section 9 Power requirements) and of equal voltage must be placed at the power input to the board.

MOTOR CABLES

Dual Twisted Pair Shielded (Separate Shields)

≤ 5 feet Belden Part # 9402 or equivalent 20 Gauge
> 5 feet Belden Part # 9368 or equivalent 18 Gauge

POWER SUPPLY CABLES

Twisted Pair (Jacketed)

≤ 4 Amps DC current Belden Part# 9740 or equivalent 18 Gauge
> 4 Amps DC current Belden Part# 8471 or equivalent 16 Gauge

SECTION 11

MICROSTEP SELECTION

The number of microsteps per step is selected by pins 7 thru 10. Table 5 shows the standard resolution values along with the associated input settings (See section 14 - Inputs).

The microstep resolution can be changed at any time. There is no need to reset or cycle power. On-the-fly “gear shifting” facilitates high speed slewing combined with high resolution positioning at either end of the move.

When the number of microsteps per step are changed such that the IM481H does not fall on a full step (i.e. zero crossing of the sine/cosine waveforms) the IM481H will re-adjust itself at the next pulse that would overshoot the full step position. This feature allows the IM481H to re-adjust the motor to position no matter what resolution is chosen or when it is changed.

MICROSTEP SELECTION

Table 5

RESOLUTION (Microsteps/Step)	STEPS/REV (1.8° Step Motors)	RESOLUTION SELECT 0 PIN 7	RESOLUTION SELECT 1 PIN 8	RESOLUTION SELECT 2 PIN 9	RESOLUTION SELECT 3 PIN 10
---------------------------------	---------------------------------	---------------------------------	---------------------------------	---------------------------------	----------------------------------

BINARY

2	400	LOW	LOW	LOW	LOW
4	800	HIGH	LOW	LOW	LOW
8	1,600	LOW	HIGH	LOW	LOW
16	3,200	HIGH	HIGH	LOW	LOW
32	6,400	LOW	LOW	HIGH	LOW
64	12,800	HIGH	LOW	HIGH	LOW
128	25,600	LOW	HIGH	HIGH	LOW
256	51,200	HIGH	HIGH	HIGH	LOW

DECIMAL

5	1,000	LOW	LOW	LOW	HIGH
10	2,000	HIGH	LOW	LOW	HIGH
25	5,000	LOW	HIGH	LOW	HIGH
50	10,000	HIGH	HIGH	LOW	HIGH
125	25,000	LOW	LOW	HIGH	HIGH
250	50,000	HIGH	LOW	HIGH	HIGH

ILLEGAL SETTINGS: MAY CAUSE ERRATIC OPERATION

	LOW	HIGH	HIGH	HIGH
	HIGH	HIGH	HIGH	HIGH

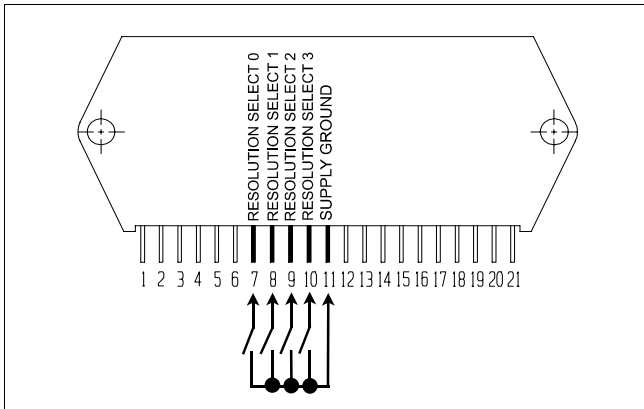


Figure 6

SECTION 12

FULLSTEP OUTPUT SIGNAL

The FULLSTEP output signal from the IM481H is an active high output at pin 18. This output is TRUE for the duration of the full step. A full step occurs when either Phase A or Phase B cross through zero (i.e. full current in one winding and zero current in the other winding). This fullstep position is a common position no matter what resolution is selected.

The fullstep output can be used to count the number of mechanical full steps the motor has traveled without having to count the number of microsteps in between. A controller that utilizes this output can greatly reduce its position tracking overhead and thus substantially increasing its throughput.

SECTION 13

TIMING

The Direction and Microstep Resolution Select inputs are synchronized with the positive going edge of the Step Clock input. When the Step Clock input goes high, the Direction and Microstep Select inputs are latched and further changes to these inputs are ignored until the next rising edge of the Step Clock input.

After these signals are latched, the IM481H looks to see if any changes have occurred to the Direction and the Microstep Select inputs. If a change has occurred, the IM481H will execute the change before taking the next step. Only AFTER the change has been executed will the step be taken. If no change has occurred the IM481H will simply take the next step. (This feature works as an automatic debounce for the Direction and Microstep Select inputs.)

The minimum pulse width for the Step Clock input is 75nS. The typical execution time for a Direction or Microstep Select change is 100nS. The typical execution time for a Step input is 100nS.

The Reset and Enable inputs are asynchronous to any input and can be changed at any time.

The Reset requires a minimum pulse width of 10 μ S (See Section 14 for more information).

The Fullstep output typically occurs 75nS after the positive edge of the Step Clock (excluding changes to the Direction or the Microstep Select inputs).

SECTION 14

INPUTS

The inputs to the IM481H are internally pulled up to the +5VDC internal supply. Figure 7 shows the inputs and their associated pull up resistor values. See Section 4, Electrical Specifications, for resistor tolerance.

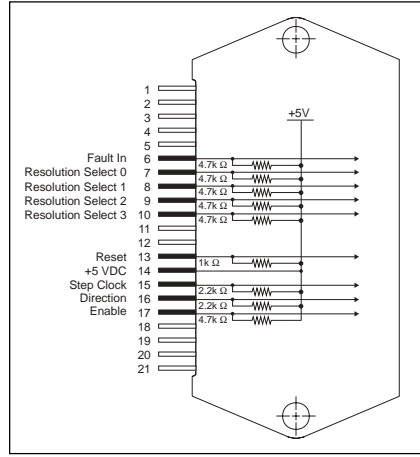


Figure 7

An open collector output is recommended when interfacing with the IM481H.

On power up, or if the Reset Input is Closed, the internal reset circuit will hold the input low for 100 to 300 milliseconds. The “holding” time does not begin until the Reset Input is Opened. (See Figure 9.)



WARNING! When interfacing the FAULT IN or RESET input, an open collector, tri-state output, or a blocking diode is REQUIRED or damage may occur to internal circuits. (See Figure 8.)



Figure 8

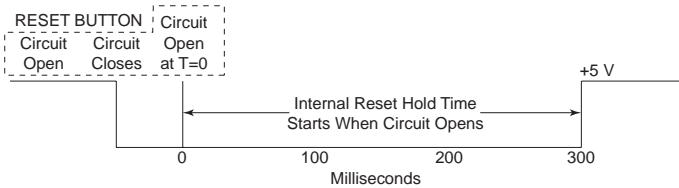


Figure 9

When controlling multiple drives with a single Reset you must install blocking diodes at the input (Pin 13) of each drive. Because of the slight differences in Reset timing, this will prevent the drives from latching the Reset Input in the LOW state. (See Figure 10.)

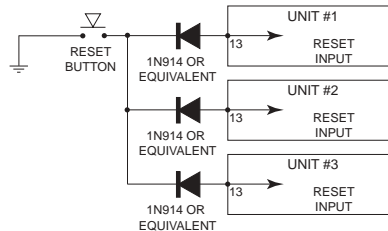


Figure 10

SECTION 15

AUTOMATIC CURRENT REDUCTION

Built into the IM481H is the ability to automatically reduce the current in the motor windings after the completion of a move. The reduction occurs approximately .5 seconds after the last positive going edge of the Step Clock input. The IM481H will then revert back to the original current setting at the next positive going edge of the Step Clock input.

To utilize this feature, the current reference output must be used to adjust the output current of the IM481H and a resistor must be connected between pins 3 & 4 (see Figure 6). The value of the resistor will determine the amount of current reduction.

The amount of current per phase in the current reduction mode is related to the value of the current reference resistor and the current reduction resistor. When the current reduction circuit is activated, the current reduction resistor is paralleled with the current adjustment resistor. The parallel combination of the current reference and current reduction resistors determine the reduced current level. The relationship between the output current and the resistor's values is as follows:

$$\text{Output Current Reduced (Amps)} = \frac{.001 \times R(\text{Current Adjust}) \times R(\text{Current Reduction})}{R(\text{Current Adjust}) + R(\text{Current Reduction})}$$

OR

$$R(\text{Current Reduction}) = \frac{\text{Output Current Reduced} \times R(\text{Current Adjust})}{.001 \times R(\text{Current Adjust}) - \text{Output Current Reduced}}$$

NOTE: Resistor values are in ohms.

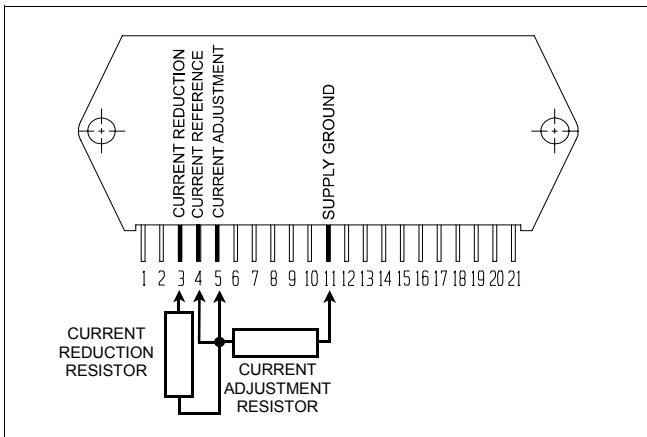


Figure 11

NOTE: When connecting the current reduction resistor between pins 4 and 5, the connections should be made as short as possible to help minimize noise coupled into the driver.

SECTION 16

FAULT PROTECTION

The IM481H is internally protected against over temperature, and over current.

The over temperature set point is between 60 and 70 °C. Care should be taken when choosing and installing a heat sink so that there is a good thermal conduction, otherwise hot spots may occur in the IM481H which will reduce the operating thermal range.

The over current protection consists of PHASE to PHASE, and +V to PHASE.

If an output driver in the IM481H detects an over temperature condition it will shut down but will not activate the fault output. Once the temperature drops to a safe operating temperature, the IM481H will resume operation.

If an over current fault is detected by the IM481H, the outputs will be disabled and cannot be re-enabled without resetting the driver or by cycling power. At the same time the active high FAULT output (pin 19) is enabled.

The FAULT IN input (pin 6) can be used to force a fault condition. When pulled low the signal is latched and the outputs will be disabled. The fault condition can only be cleared by cycling power or resetting the driver.

SECTION 17

THERMAL REQUIREMENTS

The IM481H may require heat sinking to maintain a safe operating temperature. Care should be taken when mounting the IM481H to a heat sink with an electrically conductive surface that an isolating thermal pad is used.



WARNING ! Rear mounting surface of driver contains different voltages and must be kept isolated when attached to a conductive surface !

NOTE: An optional thermal pad (Part # TI-481) and heat sink (Part # H-481) is available for the IM481H

The watts dissipated by the IM481H can be calculated as follows:

Watts Dissipated = (0.6 x (Peak per Phase Output Current)²)

EXAMPLE: Peak per Phase Output Current = 1.4 amps

Watts Dissipated = 1.18

SECTION 18

OPTIONS/ACCESSORIES

DESCRIPTION	PART NUMBER
Thermal Pad	TI - 481
Interface Board	INT-481
Heat Sink (Includes mounting hardware)	H-481
21 Pin Right Angle Connector	HY481-CN021
Small End Screw Driver	SD1

APPENDIX A

Recommended Cable Configurations: DC Supply to IMS Driver

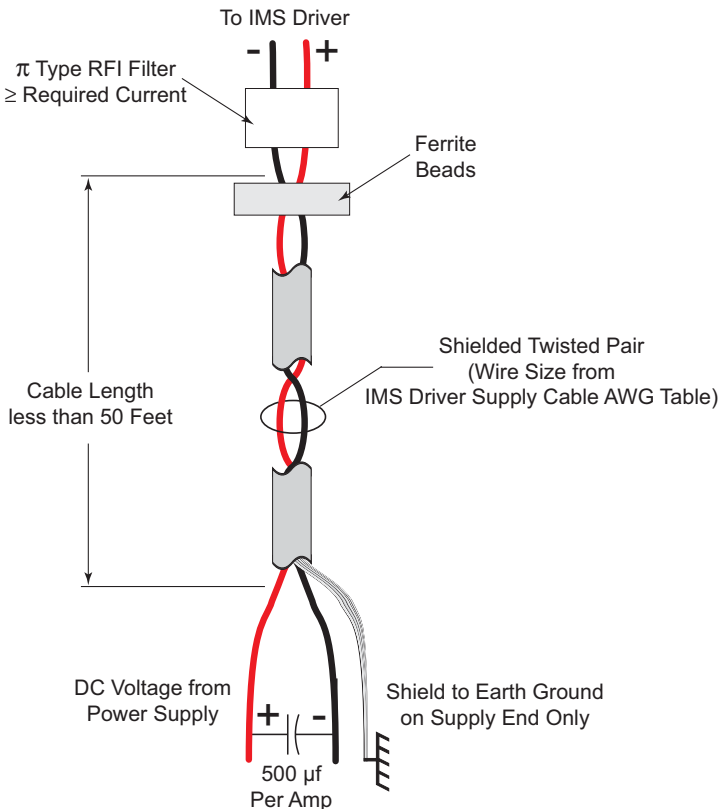
Cable length, wire gauge and power conditioning devices play a major role in the performance of your IMS Driver and Motor.

NOTE: The length of the DC power supply cable to the IMS Driver should not exceed 50 feet.

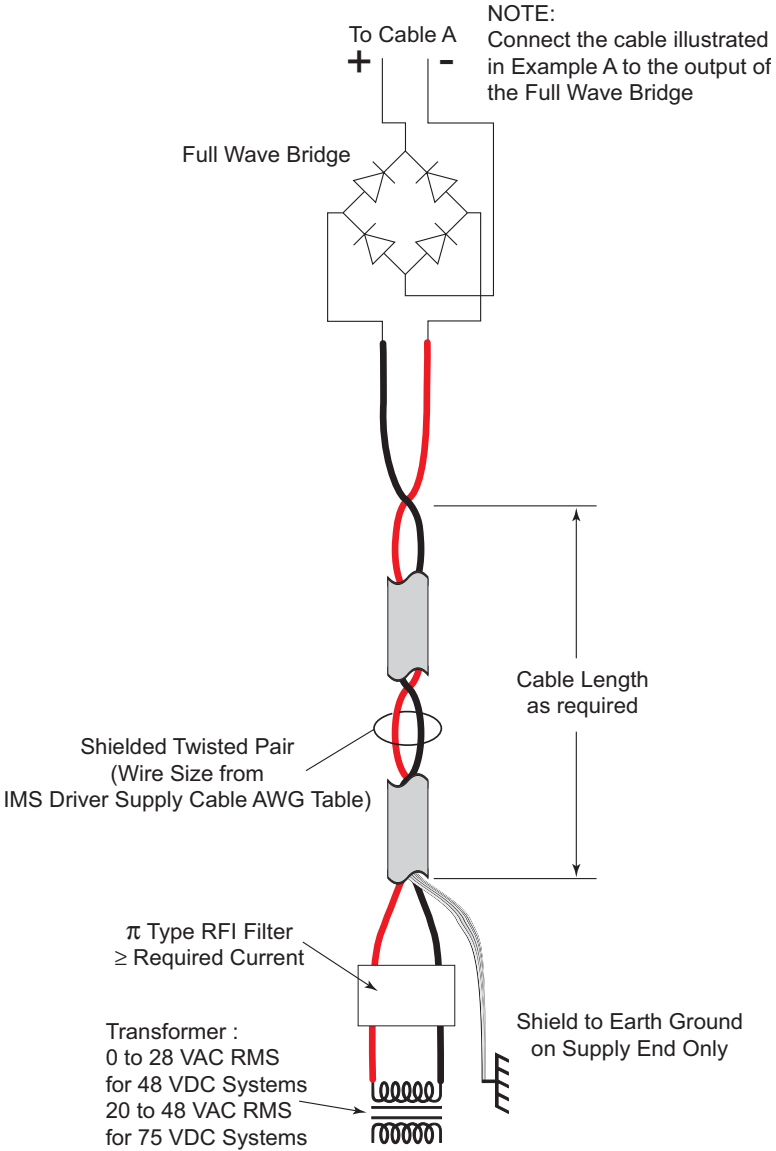
Example A demonstrates the recommended cable configuration for DC power supply cabling under 50 feet long. If cabling of 50 feet or longer is required, the additional length may be gained by adding an AC power supply cable (see Examples B & C).

Correct AWG wire size is determined by the current requirement plus cable length. Please see the IMS Driver Supply Cable AWG Table in this Appendix.

Example A – Cabling Under 50 Feet, DC Power

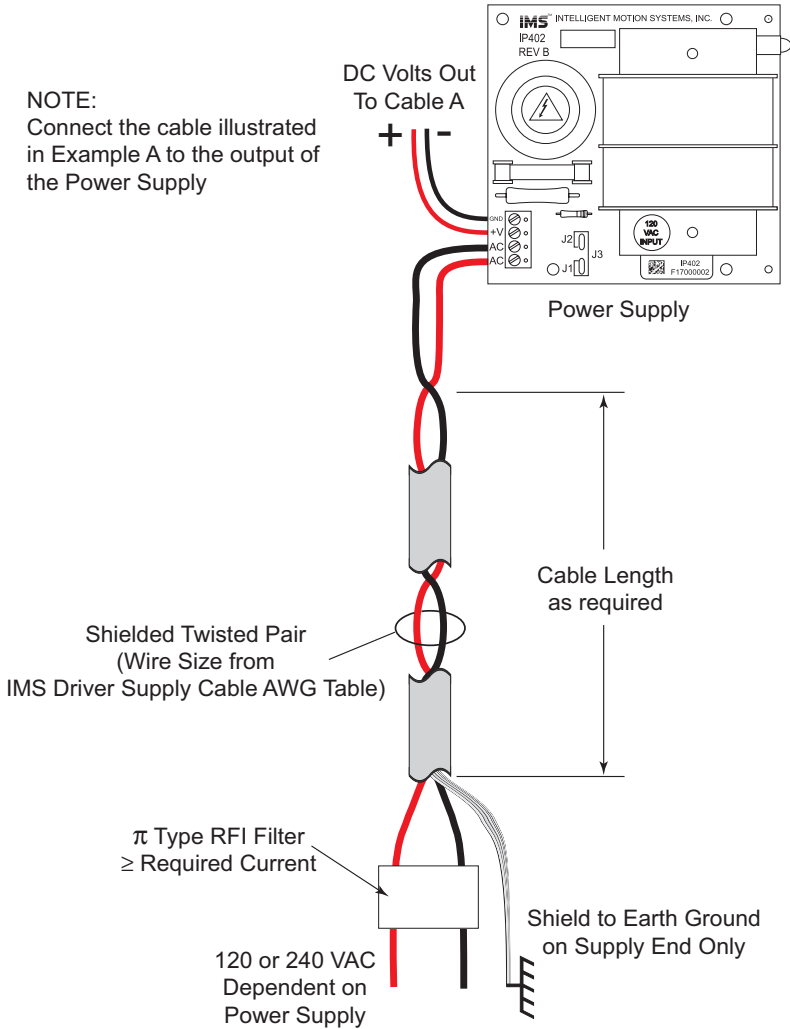


Example B – Cabling 50 Feet or Greater,
AC Power to Full Wave Bridge



Example C – Cabling 50 Feet or Greater,
AC Power to Power Supply

NOTE:
Connect the cable illustrated
in Example A to the output of
the Power Supply



N

NOTE: These recommendations will provide optimal protection against EMI and RFI. The actual cable type, wire gauge, shield type and filtering devices used are dependent on the customer's application and system.

IMS Driver Supply Cable AWG Table					
1 Ampere (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	20	18	18	16
2 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	18	16	14	14
3 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	18	16	14	12	12
4 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	18	16	14	12	12
* Use the alternative methods innustrated in Examples B and C when the cable length is \geq 50 feet. Also, use the same current rating when the alternate AC power is used.					

Driver Supply Cable Wire Size

N

NOTE: Always use Shielded/Twisted Pairs for the IMS Driver DC Supply Cable, the AC Supply Cable and the IMS Driver to Motor Cable.

Recommended Cable Configurations: IMS Driver to Motor

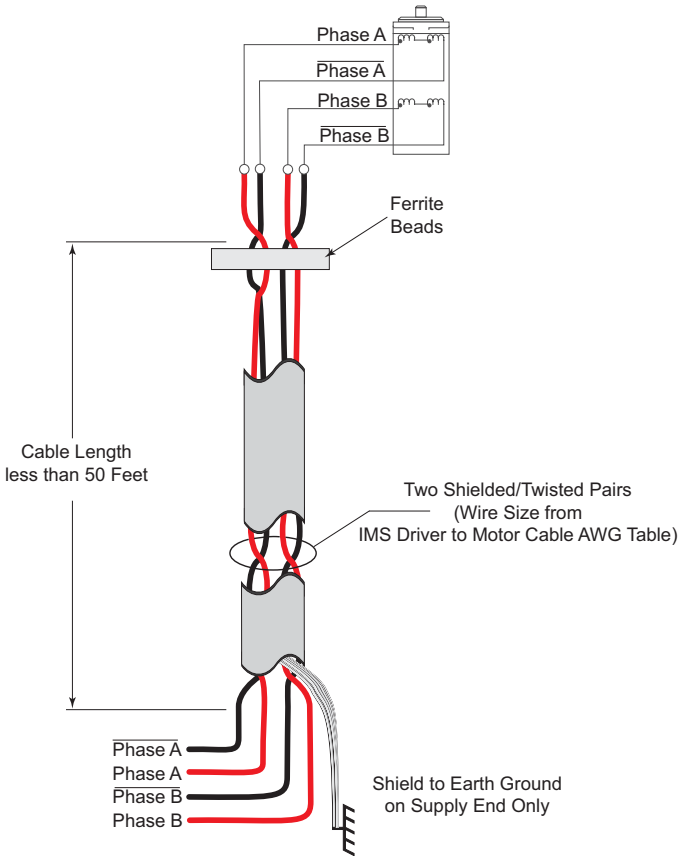
Cable length, wire gauge and power conditioning devices play a major role in the performance of your IMS Driver and Motor.

NOTE: The length of the DC power supply cable between the IMS Driver and the Motor should not exceed 50 feet.

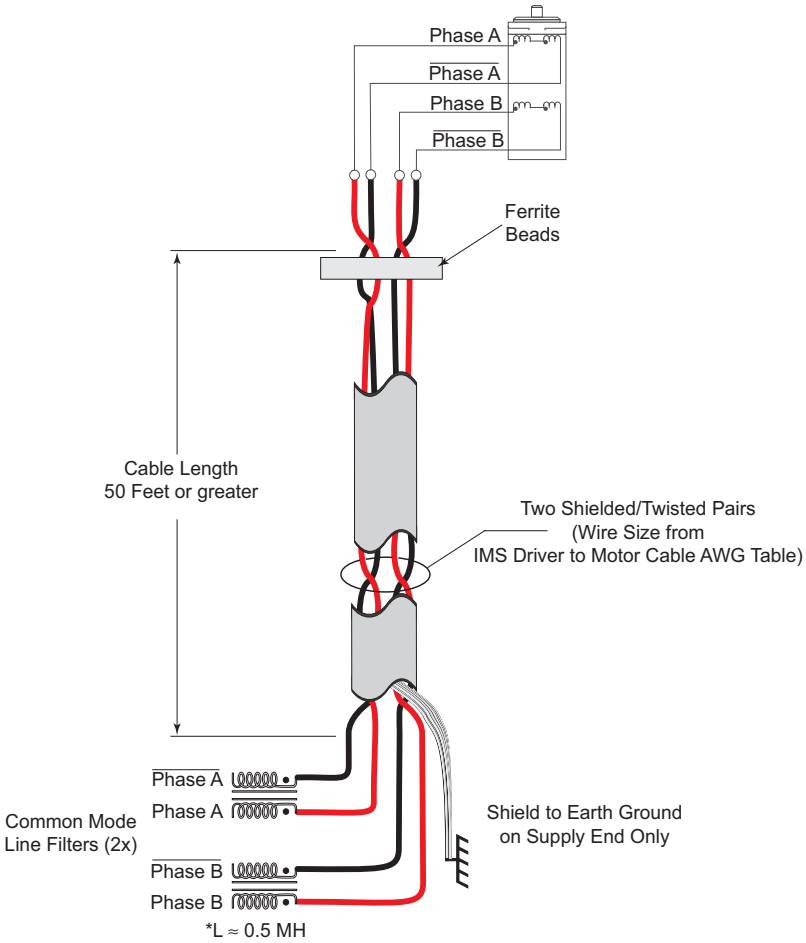
Example A demonstrates the recommended cable configuration for the IMS Driver to Motor cabling under 50 Feet long. If cabling of 50 feet or longer is required, the additional length can be gained with the cable configuration in Example B.

Correct AWG wire size is determined by the current requirement plus cable length. Please see the IMS Driver to Motor Cable AWG Table in this Appendix.

Example A - Cabling Under 50 Feet,
IMS Driver to Motor



Example B - Cabling 50 Feet or Greater,
IMS Driver to Motor



* 0.5 MH is a typical starting point for the Common Mode Line Filters. By increasing or decreasing the value of L you can set the drain current to a minimum to meet your requirements.

IMS Driver to Motor Cable AWG Table											
1 Ampere (Peak)						5 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*	Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	20	18	18	16	Minimum AWG	16	16	14	12	12
2 Amperes (Peak)						6 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*	Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	18	16	14	14	Minimum AWG	14	14	14	12	12
3 Amperes (Peak)						7 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*	Length (Feet)	10	25	50*	75*	100*
Minimum AWG	18	16	14	12	12	Minimum AWG	12	12	12	12	12
4 Amperes (Peak)						* Use the alternate method illustrated in Example B when cable length is \geq 50 feet.					
Length (Feet)	10	25	50*	75*	100*						
Minimum AWG	18	16	14	12	12						

Driver to Motor Supply Cable Wire Size

N **NOTE:** These recommendations will provide optimal protection against EMI and RFI. The actual cable type, wire gauge, shield type and filtering devices used are dependent on the customer's application and system.

N **NOTE:** Always use Shielded/Twisted Pairs for the IMS Driver DC Supply Cable, the AC Supply Cable and the IMS Driver to Motor Cable.

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WARRANTY

TWENTY-FOUR (24) MONTH LIMITED WARRANTY

Intelligent Motion Systems, Inc. ("IMS"), warrants only to the purchaser of the Product from IMS (the "Customer") that the product purchased from IMS (the "Product") will be free from defects in materials and workmanship under the normal use and service for which the Product was designed for a period of 24 months from the date of purchase of the Product by the Customer. Customer's exclusive remedy under this Limited Warranty shall be the repair or replacement, at Company's sole option, of the Product, or any part of the Product, determined by IMS to be defective. In order to exercise its warranty rights, Customer must notify Company in accordance with the instructions described under the heading "Obtaining Warranty Service."

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Warranty service may be obtained by a distributor, if the Product was purchased from IMS by a distributor, or by the Customer directly from IMS, if the Product was purchased directly from IMS. Prior to returning the Product for service, a Returned Material Authorization (RMA) number must be obtained. Complete the form at <http://www.imshome.com/rma.html> after which an RMA Authorization Form with RMA number will then be faxed to you. Any questions, contact IMS Customer Service (860) 295-6102.

Include a copy of the RMA Authorization Form, contact name and address, and any additional notes regarding the Product failure with shipment. Return Product in its original packaging, or packaged so it is protected against electrostatic discharge or physical damage in transit. The RMA number **MUST** appear on the box or packing slip. Send Product to: Intelligent Motion Systems, Inc., 370 N. Main Street, Marlborough, CT 06447.

Customer shall prepay shipping charges for Products returned to IMS for warranty service and IMS shall pay for return of Products to Customer by ground transportation. However, Customer shall pay all shipping charges, duties and taxes for Products returned to IMS from outside the United States.

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